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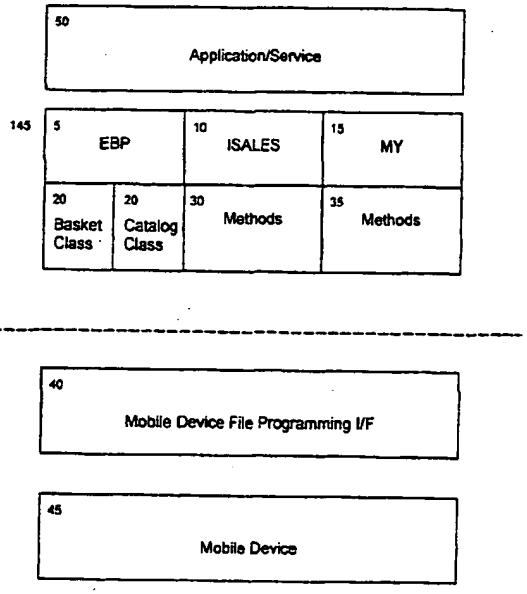
(54) Title: AN APPLICATION PROGRAMMING INTERFACE LAYER FOR A DEVICE CROSS-REFERENCE TO RELATED APPLICATIONS



(57) Abstract: An application programming interface layer for devices, such as handheld computers, personal digital assistants (PDAs), Internet enabled phones, laptops, and desktop computers or the like, that provides device independence so applications may run on any of such devices without specific programming for device specific dependencies. Such devices can run business applications offline and synchronize data with a computer system, such as a business electronic commerce system via a standard Internet connection or other network connection. Further, such devices permit allows the automatic installation and/or deinstallation of applications on the devices from the computer system.

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AN APPLICATION PROGRAMMING INTERFACE LAYER FOR A DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application arises from provisional applications 60/296,234 filed on June 6, 2001 and 60/296,993 filed on June 8, 2001 and claims the benefit thereof.

FIELD OF THE INVENTION

This invention relates to providing an application programming interface (API) layer for devices, such as handheld computers, personal digital assistants (PDAs), Internet-enabled phones, laptops, and desktop computers or the like, that provides device independence for applications running thereon. Such devices may run business applications offline and synchronize data with a computer system, such as a business electronic commerce system via a standard Internet connection or other connection. Such devices may also enable the automatic installation and/or deinstallation of applications thereon from the computer system.

BACKGROUND OF THE INVENTION

Many businesses have a need to exchange information between a central location and employees operating in the field. In the computerized age, much of this information is stored on computer systems. Because many field employees may have a mobile computing platform, such as a laptop computer, handheld computer, personal digital assistant or Internet-enabled phone with which to work. Thus, it would be beneficial to enable the exchange of information between the computer system and the devices deployed in the field.

One situation where such system would be useful is with a field engineer. At the start of a day, the engineer may need to determine his daily tasks and at the end of the day he may need to report his progress back to his employer. Rather than exchange this information verbally, it would make more sense to download the tasks he has to perform that day from a central computer system onto a mobile computing platform. When he finishes his tasks for the day, or at another convenient time, he could respond to the computer system with reports relating to the calls, setting forth the trouble found, the repair performed, the time it took to complete the job and/or any other desired information.

Another situation where such a system would be useful would be with sales personnel that call on customers. For instance, during a sales call, a customer may desire to change a previously placed order. The sales person would then need to record a modified order.

Exchanging this information through a computer system would make much more sense than doing so verbally and would also provide a computer record of the transaction.

Companies, whose employees have a need for such devices, may have different classes of employees that may need different devices for their job functions. Their needs may differ due to size constraints, processing power needs, memory requirements or other reasons. Thus, it may be necessary for a company to deploy more than one type of device that can exchange information with a central computer system. Some jobs may require the use of personal digital assistants, while others require handheld computers, while still others require laptops. Others, that do not involve travel, may require desktops. For ease of use and management, it then becomes important that the software being used to perform the various tasks be platform-independent so that it may run on all devices that such a company may utilize.

It also is important to permit the information to be entered on the devices while the device is offline. Field personnel are not always in locations where they can establish connectivity to the computer system. It would be beneficial, therefore, to enable the field personnel to enter the information they need to transmit back to the computer system when it is convenient for them, such as immediately following a repair, rather than making them enter the information while the device is online with the computer system.

It is also important for ease of use that when people are working offline, the software operates in a similar way with a similar look and feel as though they were actively operating online.

Because a company may have hundreds or thousands of mobile device users that access the computer system from time-to-time, an easy way to keep track of what software is loaded on what device and to control and manage software loads on the devices without inconveniencing the users is imperative. Thus, an easy way to control, manage, and monitor software installation on the devices is needed.

A need exists for an API layer that provides device independence for applications to be run thereon for use with mobile devices or desktop computers that run business applications offline and synchronize data with a computer systems over a standard Internet connection or other connection.

SUMMARY OF THE INVENTION

An embodiment of the present invention provides an application programming interface layer that provides device independence for business applications running offline on devices that synchronize data with a computer system over a standard Internet connection.

As such, it is an object of the present invention to permit device independence for business applications to be run on a device that synchronizes data thereon with a computer system over a standard Internet connection or other connection.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of a mobile device according to an embodiment of the present invention.

Figure 2 is a block diagram of a mobile device having an API layer according to an embodiment of the present invention.

Figure 3 is a block diagram of a synchronization system according to an embodiment of the present invention.

Figure 4 is a block diagram of a computer system having a synchronization system according to an embodiment of the present invention.

Figure 5 is a flow chart illustrating a synchronization process according to an embodiment of the present invention.

Figure 6 is a block diagram of a deployment console according to an embodiment of the present invention.

Figure 7 is a flow chart illustrating a deployment process according to an embodiment of the present invention.

Figure 8 is a flow chart illustrating a deployment process according to another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will be better understood by reference to the accompanying drawings.

Figure 1 depicts a mobile device according to an embodiment of the present invention. Mobile device 100 may be a PDA, a laptop computer, an Internet capable phone,

or another similar device. Preferably, the mobile device has an operating system with Java VM 1.1.4 or PersonalJava and at least about 5 MB of memory. Preferably, mobile engine 110 is based on Java, so that it may run on any platform supporting Java.

Mobile device 100 contains an Internet browser 105. It also contains mobile engine 110. Mobile engine 110 should be capable of generating any standard markup language, such as HTML, so that Internet browser 105 may be a standard browser, such as Microsoft Internet Explorer or Netscape, rather than a proprietary one. However, a proprietary browser could be used on mobile device 100 in addition to or in lieu of the standard browser if desired.

When mobile device 100 is operating with a computer system over the Internet in an online mode and applications are being run from computer system 200 across the connection, browser 105 is connected to computer system 200, such as an application server, in a traditional manner represented by box 197.

When mobile device 100 is operating in an offline mode and applications are being run locally on mobile device 100, mobile engine 110 is engaged. Mobile engine 110 contains two major components: a Java plug-in 90 and various components for data synchronization and deployment. The Java plug-in contains web server 115, servlet engine 120, modular offline application building blocks 125, 130 and 135, and API layer 145. All of the information to start and run the Java plug-in is preferably held in separate property files. For instance, the information related to the web server, including host, port, and wwwroot, can exist in a file named webserver.properties. The information related to mappings, such as URL to servlet mappings, can exist in a file named mappings.properties. The information relating to mimes, such as mime types, can exist in a file named mime.properties.

Web server 115 is preferably programmed in Java and provides the ability for the user of mobile device 100 to log onto web server 115 contained within mobile device 100 when operating offline. By doing so, the user is provided with the same or similar look and feel to operating online over the Internet and can run the same applications offline that the user could run over the Internet in an online mode. Preferably, web server 115 is single threaded and has a small footprint.

Web server 115 is connected to servlet engine 120. Servlet engine 120 enables the mobile device's user to engage various offline applications locally on mobile device 100 through web server 115. Servlet engine would preferably be based upon Java Servlet API

2.1. Web server 115 and servlet engine 120 preferably would meet the Sun Java WebServer 2.0 Specification.

Various different programming models can be deployed in mobile engine 110 as modular offline building blocks. For instance, a proprietary model 125, like SAPMarket's MicroITS, may be deployed which is designed to maximize certain types of transactions based upon the foreseen use of mobile device 100. MicroITS model 125 contains a flow logic parser, HTML business parser, language resource parser/preparser and module provider.

A Java Server Pages model 130 may be deployed to take advantage of Java features. Java Server Pages model 130 would preferably be based upon TomCat.

Other models, such as custom plug-in model 135, can also be used as needed. Custom plug-in model would permit users to implement their own logic. These other models may be proprietary or standards-based. By using modular offline application building blocks and permitting the use of one or more models, the mobile engine architecture is easy to enhance or modify. Moreover, new offline application building blocks can be downloaded and installed via the deployment and installation process discussed hereinafter with respect to Figures 6 and 7. Mobile engine API layer 145, which will be discussed in more detail below, provides independence between modular offline application building blocks 125, 130, 135 and servlet engine 120.

Modular offline application building blocks 125, 130, and 135 utilize programming sources stored in memory 140. While memory 140 is shown within mobile engine 110, it may be located elsewhere.

Mobile engine API layer 145 forms an interface between the various programming models 125, 130 and 135 and the application data that resides on database 180 within mobile device 100. While database 180 is shown within mobile engine 110, it may be located elsewhere. By providing API layer 145, alternative programming models, offline applications and services may be incorporated, activated or substituted for existing models, offline applications and services in the future without having to completely reprogram mobile engine 110. API layer 145 contains file I/O APIs, database APIs, synchronization layer APIs and XML parsing APIs.

This mobile engine API layer 145 also provides device independence so that any application can run on any device without specific programming for device specific dependencies. Referring now to Figure 2, API layer 145 provides an interface between application or service 50 and the mobile device's file programming interface 40 on the mobile device platform 45. Service 50 may be any of the previously mentioned services, such as data exchange 150, or the like, or an offline application.

API layer 145 consists of various module providers, such as EBP.class 5, ISALES.class 10 and MY.class 15. Java methods grouped in packages 20, 30, and 35, such that all methods needed for a specific function are part of a corresponding package, also form part of API layer 145. These methods can be called by the appropriate module provider.

For instance, Enterprise Buyer Professional is a product available from SAP Markets, Inc. It provides the ability to coordinate the Internet business procurement process. The product permits the creation of shopping baskets and catalogs. A package for Enterprise Buyer Professional would include the module provider of EBP.class 5 and the groups of methods basket.class 20a and catalog.class 20b.

Module providers 5, 10, and 15 instantiate the appropriate Java method calls and make them available for the flow logic in an application or service. There is always one module provider assigned to each package of the API layer 145.

Various services that can be integrated that operate through API layer 145 are shown. Data exchange 150 is utilized during a synchronization procedure when data is to be exchanged between a computer system and mobile device 100.

Many business applications utilize XML. So an XML translation service 155 can be provided.

A personalization service 160 can be included. Personalization permits the manipulation of settings necessary to operate within a given server environment, such as a server URL, logon data, proxy, etc. Multiple user control can be included if more than one user of a device would be anticipated.

An installation service 165 can also be provided. Installation service 165 automatically installs or uninstalls offline applications, offline application building blocks and other software so that the device is outfitted as it should be based upon a deployment console, as will be discussed in detail later, located at the computer system. The installation

service 165 creates a new entry in registry service 175 (discussed below) when a new application is installed and deletes an entry when an offline application is deleted. This function occurs in the background so as to be transparent to the user.

Local database access 170 is provided to permit access to database 180.

A home service 172 can be provided that sets up a homepage that the user accesses offline that provides links to the offline applications resident on the mobile device. Preferably, the synchronization service is accessible through this page by clicking on an icon, for example.

Library service 174 offers standard functionality for application methods. It handles file operations and parsing. Library service 174 contains an open catalog interface and parser for XML parsing, as well as a local data storage encryptor.

Registry service 175 maintains a list of all installed offline applications. Alternatively, registry service 175 can maintain a list of all installed software subject to deployment from the deployment console, which would include at least offline applications and modular offline application building blocks. Preferably, information from the registry 175 is provided to the deployment console during a synchronization and used by the deployment console to make sure that mobile device 100 is outfitted as it should be. The operation of registry service 175 will be discussed in more detail later.

Synchronization layer 185 is part of mobile engine 110. Synchronization layer 185 controls the synchronization of data on mobile device 100 with computer system 200 once the mobile device achieves connection through the Internet (or alternatively, through another means) to computer system 200, such as an application server, as is represented by box 195. The synchronization layer 185 does this by sending the data containers resident in synchronization folder 187. Synchronization layer 185 preferably will contain an inbound/outbound queue, module(s) supporting different types of synchronization, a file handler, an error handler, a SOAP connector for XML, a data transmission security module, a synchronization security module and an authority checker. The details of the creation of such components would be apparent to one skilled in the art. This synchronization layer 185 and synchronization process will be discussed in greater detail later.

A few examples of offline applications that can be run on mobile device 100 are now discussed. Such applications can be created through the use of a tool such as Web

Application Builder by SAP, AG. One such application is an easy shopping application. Easy shopping permits one-step wireless shopping and buying, personalized product offerings, seamless integration into a full internet sales cycle, seamless integration into a procurement cycle, intelligent status tracking/synchronization, easy changing web templates, XML catalog content exchange, and provides the identical look and feel for sales and procurement. Functions supported could be catalog, shopping cart, synchronization, and order status. The catalog can include search functionality and can hierarchically group products. The shopping basket allows for the creation of multiple orders and provides order status information. When this data from this application is synchronized with the central computer system, catalog content, orders, and software can be updated.

Manager's inbox is another possible offline application. Manager's inbox contains an inbox overview listing incoming messages and work items. View selection can be available. When an inbox item is clicked, the message or the work item can be displayed. Work item details such as the ability to approve or reject a work item and forms can be shown. During synchronization, inbox items, item details, and approvals/forms would be updated.

Plant maintenance is another application. Plant maintenance includes an order section. Functions possible with plant maintenance could include searching for open or released orders, selecting operations, and adding components. The catalog function can provide a hierarchical view catalog with search functionality. During synchronization open and released orders would be exchanged, catalogs would be updated and new components would be added.

The discussion above, with respect to Figure 1, focused on the use of the framework with a mobile device. Another use for this framework would be to install it as described above on a desktop computer rather than a mobile device or on a laptop that has a more or less permanent network connection. Having such a framework would permit users to run applications offline and then exchange information between the desktop and the computer system during a synchronization process. Thus, when offline application data needs to be provided to the computer system, it is provided to the system through the synchronization layer. The synchronization process can occur upon the clicking of an icon or hyperlink or the like, or alternatively, because a network connection does exist, it can automatically be provided without user intervention when data is available to be sent.

By using the mobile engine framework on a desktop, or laptop with a somewhat permanent network connection, the volume of exchange of information between the computer system and the desktop can be minimized. This would mean that entire HTML pages would no longer need to be exchanged. Instead, just the data of the business objects would be exchanged.

In Figure 3, a synchronization system according to an embodiment of the present invention is shown. Mobile device 100 is shown connected to computer system 200 through a connection such as the Internet. Other networks or a direct connection can alternatively be used. The synchronization process could begin through clicking on an icon, button, hyperlink or the like, on a home page displayed via the browser. Alternatively, it could automatically occur upon a link being established between mobile device 100 and computer system 200.

Sample Java code for initiating a synchronization process follows:

```
try{
  SyncOutboundContainer.doSync();
} catch (SyncException ex) {
  // do something
}
```

Mobile engine 110, through API layer 145 and synchronization layer 185, talks with functional module 220 on computer system 200 through synchronization RFC 210. This communication is carried out through the use of data containers, such as data container 230.

Data container 230 is normally made up of a header 240 and a body 250. However, certain types of containers may not require a body 250. The header 240 can be made up of the following parts: 1) a container ID that uniquely identifies the particular container; 2) an identification of the user of the device; 3) an identification of the type of container; 4) the method describing which function module should be called in the computer system to process the data; 5) the date the container is sent; 6) the time the container is sent; 7) the date the method was executed to create the data container; 8) the time the method was executed; and 9) the status relating to the data. The body 250 of container 230 can be made up of a container ID, line number, field name and field value.

The following is sample Java code for an outgoing data container:

```
String MyOwner;  // best the username on the PDA
try{
 SyncOutboundContainer syncOutboundContainer = new
SyncOutboundContainer(MyOwner,GETAPPROVERLIST );
 syncOutboundContainer.open();
 String value_for_I_CFGUID = //  do something to fill value
 syncOutboundContainer.addItem("I_CFGUID", 0 ,value_for_I_CFGUID);
 String value_for_I_OBJTYPE = //  do something to fill value
 syncOutboundContainer.addItem("I_OBJTYPE", 0 ,value_for_I_OBJTYPE);
 int NoOfLinesInTable_E_APPROVER;
 for (int line=0; line < NoOfLinesInTable_E_APPROVER ; line++) {
  String line_for_E_APPROVER = //  do something to fill line
syncOutboundContainer.addItem("E_APPROVER",line,line_for_E_APPROVER
);
 }
 syncOutboundContainer.close();
} catch (SyncException ex) {
// will always happen if method "GETAPPROVERLIST " is not registered
}
```

Figure 4 shows a computer system with synchronization capability and Figure 5 shows a synchronization process according to an embodiment of the present invention. Preferably, the synchronization layer on the computer system has an inbound/outbound queue, module(s) for different types of synchronization, a dispatcher, a spooler, a file handler, an error handler, a mapping algorithm, a data transmission security module, a synchronization security module, and an authority checker. The details of the creation of such components would be apparent to one skilled in the art.

The embodiment shown in Figure 5 includes an optional data preservation scheme. In order to preserve the containers, a container is maintained on at least one location. The container on the mobile device will remain on the mobile device if a problem occurs such as

the connection getting lost during synchronization. If that occurs, it will be sent automatically with the next synchronization. If there is no entry in the mapping table for the function module call, the container remains in the incoming table on the computer system and a program is used to generate an automatic mapping, as will be discussed later.

If the called function module aborts and creates a dump, the container remains in the incoming table. If the called function module has the wrong interface implemented, it remains on the incoming table. If the data contained in the container is errored, the called function module returns an error message to the mobile device for processing by the offline application.

Making reference now to Figures 4 and 5, in step 230 of Figure 5, the user of mobile device 100 clicks the synch icon, button, hyperlink, or the like, on the home page to initiate the synchronization process. The synchronization class reads all data containers in the synchronization folder and compares the containers with a history table that records the container IDs for containers already sent by the mobile device 100 and received by computer system 200 as shown in step 232. This is done so that duplicate containers, should they arise for some reason, such as a reboot of the mobile device, can be deleted from the mobile device without sending them.

In step 234, the synchronization class sends the remaining containers over the synchronization transport layer to synchronization RFC function module 210 in the computer system in step 252. In step 236, the synchronization RFC function module 210 writes the incoming containers into container database 260. The incoming containers are stored in database 260 as a failsafe to ensure that the containers are available should a problem occur after they are passed on to mapping layer 265. Synchronization RFC function also reads out from the outgoing container database 275 any data containers with the same class and user as those received and sends them to mobile device 100. Additionally, it sends an acknowledgement for the containers just received and stored in incoming container database 260.

In step 238, the mobile device 100 then writes the container ID referred to by the acknowledgment into a history table indicating that it was previously received by the computer system 200 and no longer needs to be maintained on the mobile device 100. The container is then deleted off of mobile device 100.

In step 240, the incoming containers are read out of inbound container database 260 by scheduled function module 265. In step 242, scheduled function module 265 consults mapping table stored in database 270 to map the data within the container so that it may be processed accordingly. Scheduled function module 265 then calls the appropriate function module 220 to execute the function required in step 244. One such function module could be an EBP processing function, for example.

In step 246, appropriate function module 220 sends back responsive data, such as status, to scheduled function module 265. Scheduled function module 265 then places the data in a container and writes it to outgoing container database 275 in step 248. Depending on the type of incoming containers, the responsive outgoing containers may be sent immediately in step 249 or may be stored until the next time a synchronization process is initiated.

At least three separate types of synchronization would preferably be supported. The first type is publish synchronization. In publish synchronization, the type of container used can be called an outbound container. The outbound container is created in mobile device 100 and, when a connection is present, is sent to computer system 200 for processing. Once it has been received by computer system 200, any return containers waiting to be sent to the same user and of the same method are sent back to the user. The connection is terminated however, prior to any outgoing containers responsive to the data just sent by the user being sent back to the mobile device.

The second type of synchronization is online processing. This type is similar to publish but includes return of responsive outgoing containers having processed data relating to the container that was just sent. With online processing synchronization, the owner sends a request-type container. First the connection is made. Then the request-type container is sent. The container is then received by the computer system 200. Because it is a request type container, the computer system returns not only any containers waiting to be sent to the same owner of the same method, but also processes the incoming container and sends a response to that container prior to the connection being terminated.

The third type of synchronization is subscribe. Subscribe synchronization is used to check on the status of previously sent containers. For instance, it can be used to check on the status of an electronic order placed through a shopping cart. The owner sends a notify-type container to computer system 200. Computer system 200 then returns containers of same

method and user. Such containers need not include a body, as the status information is contained within the head of the containers.

Development tools can be utilized with the mobile engine according to an embodiment of the present invention. On the computer system, a generator tool can generate the wrapper function module that maps the generic structure of a container to the individual interface of a function module and generate the table entries for the mapping table. Preferably, the tool will utilize the programming language of the computer system. A tool can also be used as a Java class generator to handle flow logic to Java for modular offline application building blocks 125 and/or 135. Preferably, the tool utilizes Java on the mobile device. These tools are essentially translators. Creation of such translators would be well within the abilities of one of ordinary skill in the art. A computer aided test tool can also be created and used for modular application building blocks 125 and/or 135.

Referring now to Figure 6, to handle the management of the myriad of differently programmed mobile devices, a deployment console 400 is resident on the computer system as one of the application function modules 220. Deployment console 400 is preferably programmed in a language supported by computer system 200. For example, if the computer system is a MySAP Workplace system by SAP, AG, then the deployment console could be programmed in ABAP.

Deployment console 400 has an overview of all installed offline applications per user and device through an installation log 432 that records that an installation has occurred whenever an offline application, modular offline application building blocks or other software is deployed and installed on a device.

Some computer systems serving a plurality of users install applications according to user roles. For example, an employee may have a role of salesman, field engineer, secretary, or the like. Role assignment module 410 permits an administrator to assign a user to a role and to assign what software should be installed for each role. A user may have one or more roles if desired.

Because, in some cases, deviation from a strict role-based regiment may be desired, personal assignment module 412 can be provided. Personal assignment module 412 would permit an administration to assign an application that may be needed by an individual, but not by others within the same role. For example, a vice president of sales may be assigned a role

of vice president, but may need some but not all applications of the salesman role. Personal assignment module 412 would permit such customization.

The deployment console 400 can also manage versions of software for deployment by defining the current version of each offline application that should be installed. Version control module 416 provides an administrator with this functionality.

Storage media, such as database 418, keeps track of what software should be installed on each device for each user. This data stored therein is based upon the parameters set by role assignment module 410, personal assignment module 412 and version control module 416.

Storage media 436 is provided upon which software that may be downloaded to a device and installed thereupon is provided. Such software may include offline applications, modular offline application building blocks, patches, and other software.

Installation protocol module 434 is provided. It permits an administrator to update or alter installation protocol.

Device type/ID handler 440 is provided which determines how to handle different device types.

Installer 430 is provided that retrieves software from storage media 436 for downloading and installation on a device. This is done based upon the comparison of information from a registry service on a device to information stored in database 418 relating to what is supposed to be resident on that particular device. Additionally, installer 430 is equipped to provide mobile device with a deinstall instruction should the information from the registry service indicate that software is installed on the device that should not be.

When installer 430 retrieves software from storage media 436 and sends it off to a device and retrieves a notice from the device that the software was received, it stores the information relating to the download and install in install log 432. Install log 432, database 418, and storage media 436 may be collocated or separate. Moreover, they may be a part of deployment console 400 as shown, or alternatively, any of them may be located externally.

A process for deploying and installing the framework according to an embodiment of the present invention is shown in Figure 7.

In order to install the mobile engine framework, a user opens browser 105 on mobile device 100 and connects to computer system 200 online as shown in step 300. Once online,

an install mobile engine icon, hyperlink or the like is displayed. In step 305, the user selects to install mobile engine 110 by clicking on the icon, hyperlink or the like.

In step 310, the mobile engine framework is downloaded to mobile device 100 and, preferably, is automatically installed by installation service 165. Once installation is complete, the user connects into the deployment console system in step 315.

Upon this connection, a data container containing information from registry service 175 is sent to a deployment console on computer system 200. As shown in step 325, the console reads the registry and determines that no offline applications are currently installed on mobile device 100 and then downloads the appropriate applications that are supposed to reside on mobile device 100. These offline applications are installed automatically by installation service 165. Installation service 165 also automatically updates registry service 175 to reflect the installation of the new offline applications.

When a deployment console receives information from a registry service that indicates an outdated version of a program or a version requiring a patch is resident on a mobile device, the current version and/or patch can be sent to the device and installed and the old version deinstalled, as needed, just as any other program, as will be described with respect to Figure 8. It should also maintain error logs sent by the mobile devices.

In Figure 8, a process using the registry in association with the deployment console is depicted. In step 350, the user opens browser 105 and connects to computer system 200 through the Internet, or the like, using the synchronization function. As part of the synchronization process, mobile device 100 then sends a data container containing the data within the registry service 175 that is eventually retrieved by the deployment console as shown in step 355. This retrieval may be in the manner discussed above relating to the retrieval of data from data containers during the synchronization process.

The console then compares the data from registry service 175 to stored information that reflects what offline applications (or alternatively what software that is subject to deployment through deployment console) are supposed to be resident on mobile device 100 in step 360. In step 365, it is determined if changes need to be made to the mobile device. A few examples of changes that may need to be made include: 1) an offline application may no longer be authorized and may need to be deleted from the mobile device; 2) a new application may need to be added; 3) a new version of an existing application may need to be placed on the mobile device; 4) a patch for an existing application may need to be installed on the

mobile device; 5) modular application building blocks may need to be deleted and/or installed; and 6) other software such as special extra HTML pages and /or graphics, for example, may need to be added or deleted, such as for a "Christmas" special.

If no changes need to be made, then the routine ends. If changes do need to be made, it is determined if a deinstall or an install needs to be performed. In step 370, it is determined if a deinstall is needed. If one is, then a data container is sent to mobile device 100 directing installation function 165 to deinstall the appropriate offline application or other software. It is then determined if an install is necessary in step 385. If no install is needed, then the routine ends. If an install is needed, in step 390, the offline application or other software to be installed is downloaded to mobile device and installed automatically through the installation function 165.

This sending of the registry occurs each time there is a synchronization process. This way the deployment console keeps the mobile devices outfitted as they should be.

Although the preferred embodiments of the present invention have been described and illustrated in detail, it will be evident to those skilled in the art that various modifications and changes may be made thereto without departing from the spirit and scope of the invention as set forth in the appended claims and equivalents thereof.

What is claimed is:

1. An application programming interface layer for use on a plurality of different types of devices, said application programming interface layer providing device independence for applications running thereon, comprising:

a plurality of module providers; and

a plurality of packages of methods, each of said packages comprising methods needed for a function, wherein each of said packages is associated with one of said plurality of module providers.

2. An application programming interface layer as in claim 1, wherein said methods are Java methods.

3. An application programming interface layer as in claim 1, wherein said plurality of packages of methods comprise a basket class and a catalog class.

4. An application programming interface layer as in claim 1, wherein said plurality of devices comprise at least two of a PDA, a Internet-enabled phone, and a laptop computer.

5. An application programming interface layer as in claim 1, wherein said application programming interface layer further permits programming models, offline applications and services to be loaded and installed on said devices without intervention from a programmer.

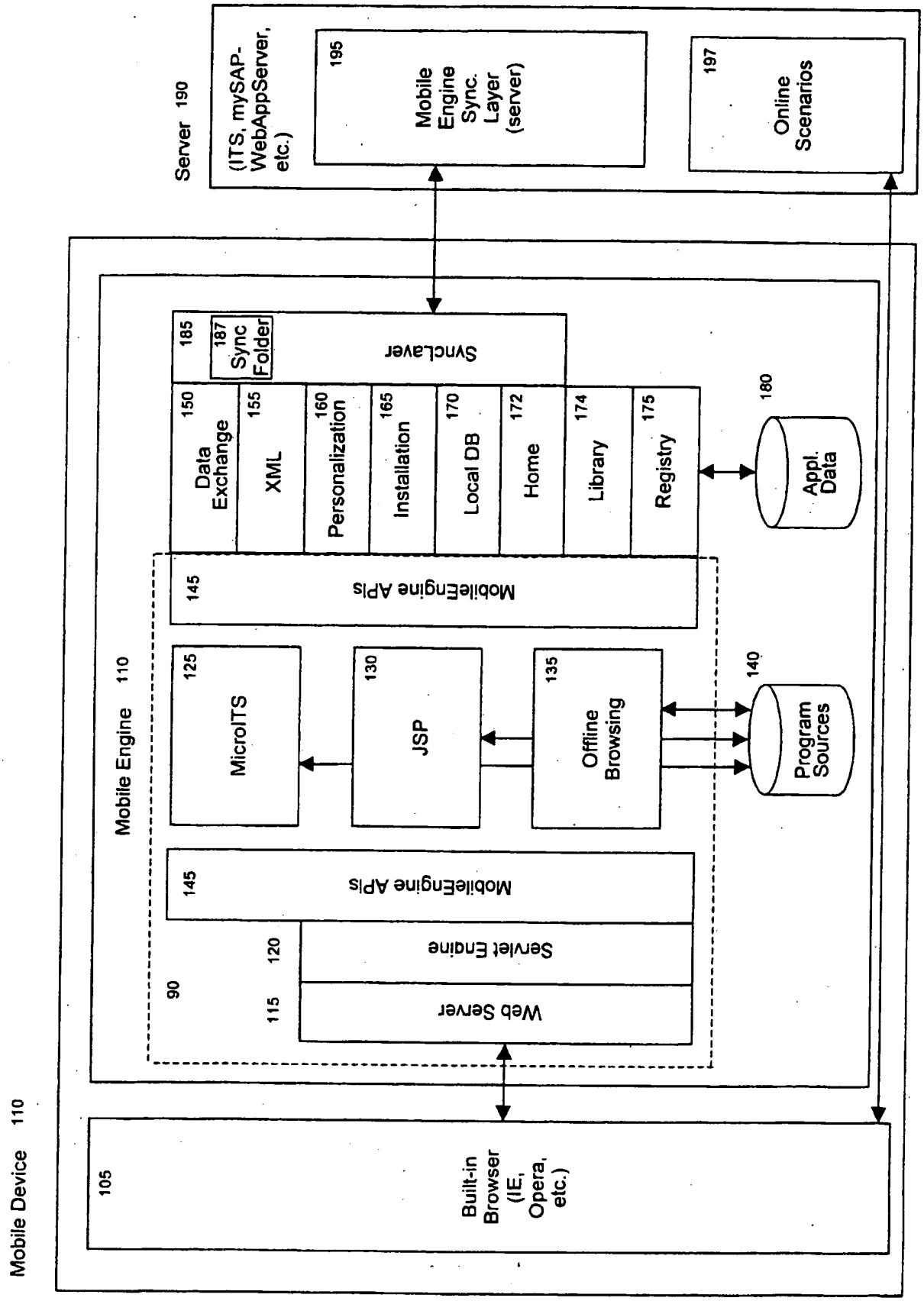
Server 190
(ITS, mySAP-WebAppServer, etc.)
195
Mobile Engine Sync. Layer (server)
197
Online Scenarios
Mobile Device 110
Mobile Engine 110
185
187
Sync Folder
SyncLayer
150
Data Exchange
155
XML
160
Personalization
165
Installation
170
Local DB
172
Home
174
Library
175
Registry
180
Appl. Data
145
MobileEngine APIs
125
MicroITS
130
JSP
135
Offline Browsing
140
Program Sources
145
MobileEngine APIs
120
Servlet Engine
115
Web Server
90
105
Built-in Browser (IE, Opera, etc.)

Fig. 1

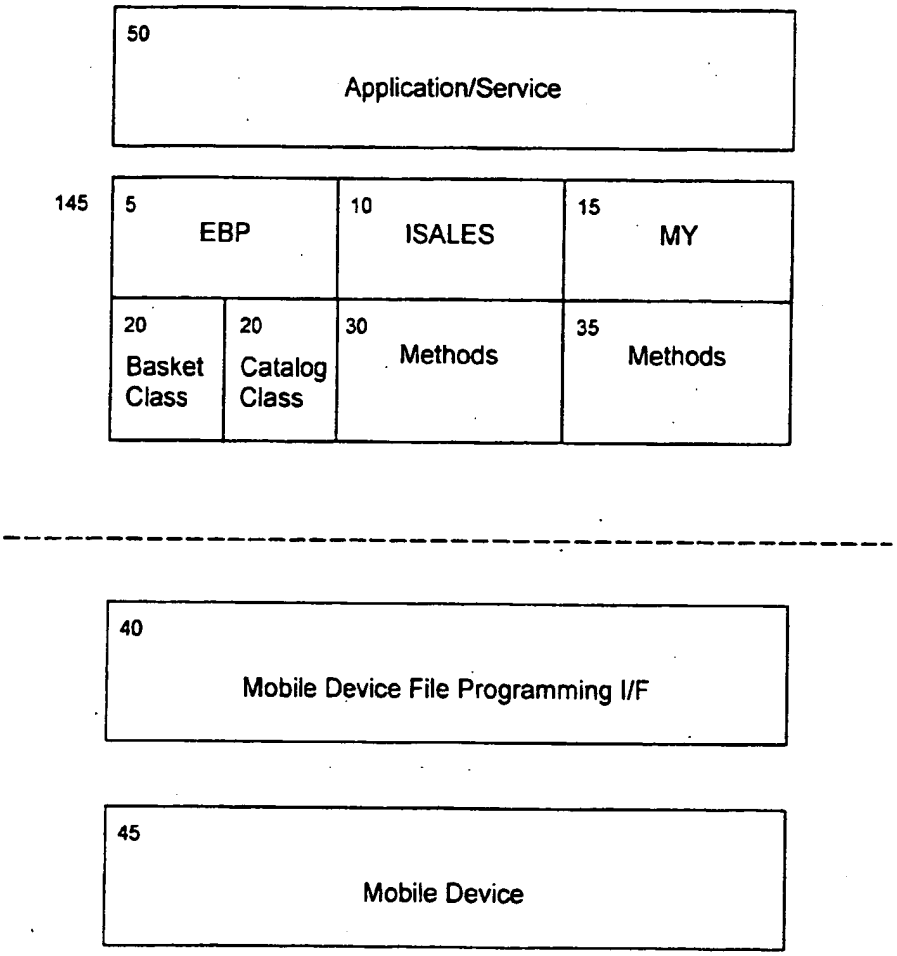
50
Application/Service
145
5
EBP
10
ISALES
15
MY
20
Basket Class
20
Catalog Class
30
Methods
35
Methods
40
Mobile Device File Programming I/F
45
Mobile Device

Fig. 2

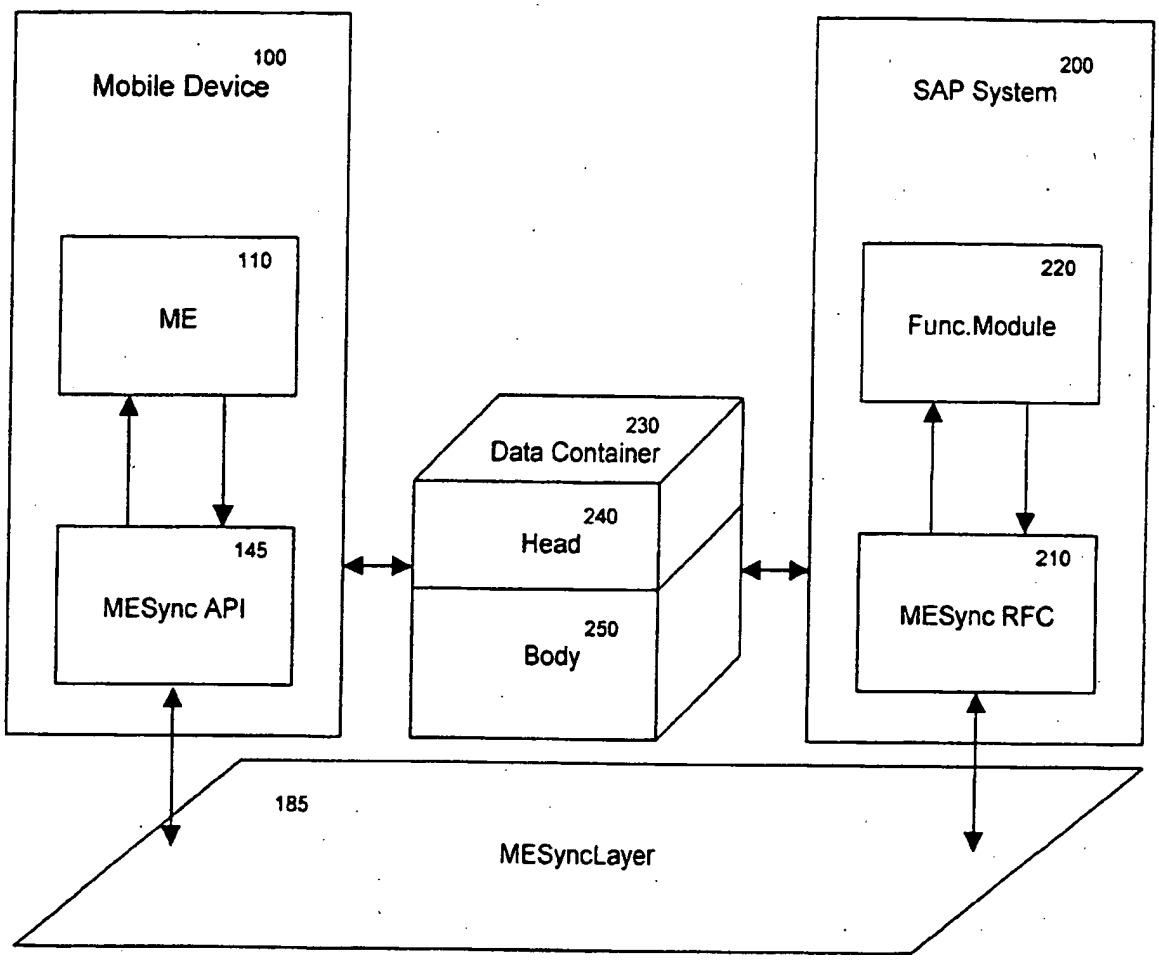
100
Mobile Device
110
ME
145
MESync API
200
SAP System
220
Func.Module
210
MESync RFC
230
Data Container
240
Head
250
Body
185
MESyncLayer

Fig. 3

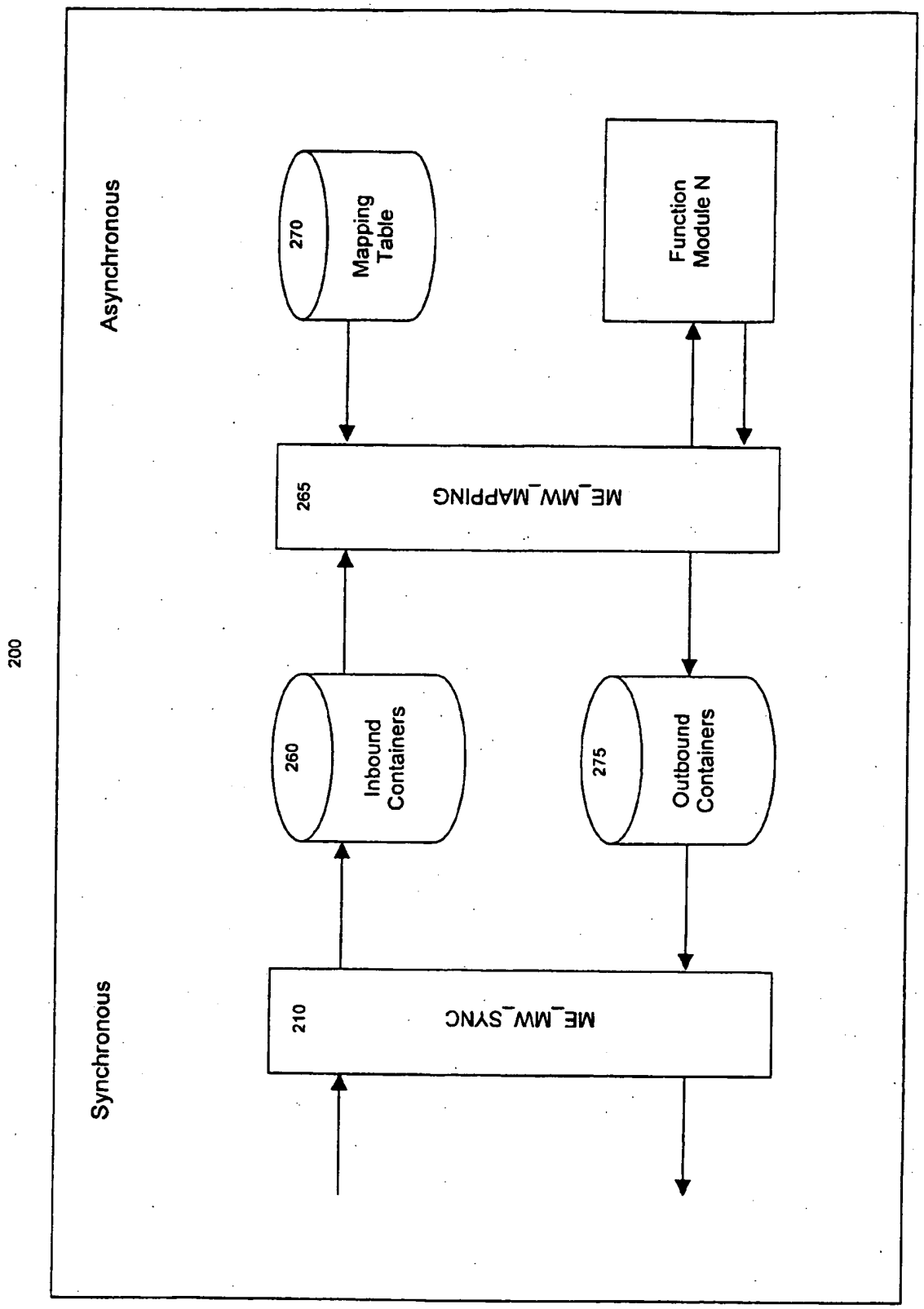
200
Asynchronous
Synchronous
270
Mapping Table
Function Module N
265
ME_MW_MAPPING
260
Inbound Containers
275
Outbound Containers
210
ME_MW_SYNC

Fig. 4

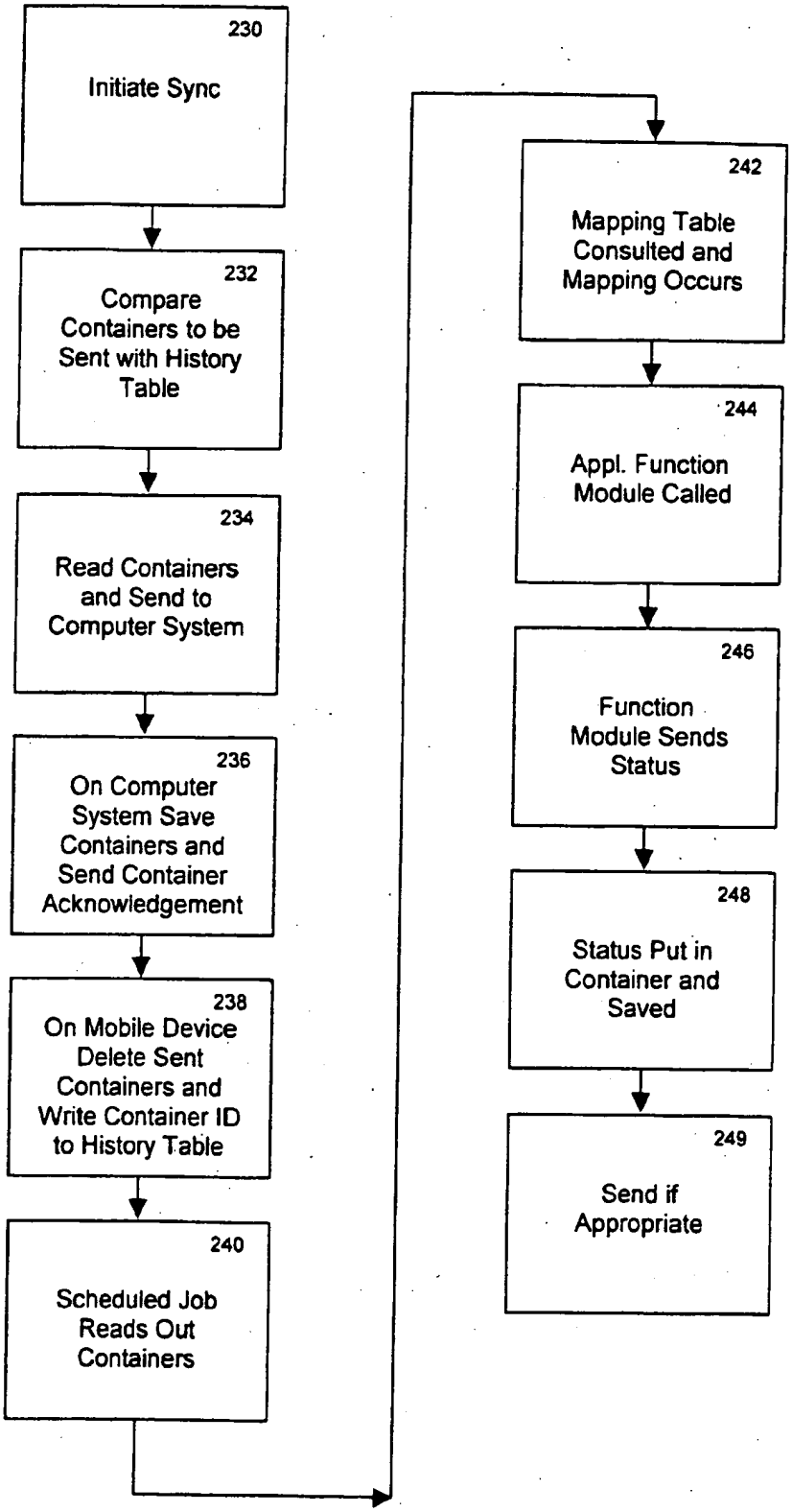
230
Initiate Sync
232
Compare Containers to be Sent with History Table
234
Read Containers and Send to Computer System
236
On Computer System Save Containers and Send Container Acknowledgement
238
On Mobile Device Delete Sent Containers and Write Container ID to History Table
240
Scheduled Job Reads Out Containers
242
Mapping Table Consulted and Mapping Occurs
244
Appl. Function Module Called
246
Function Module Sends Status
248
Status Put in Container and Saved
249
Send if Appropriate

Fig. 5

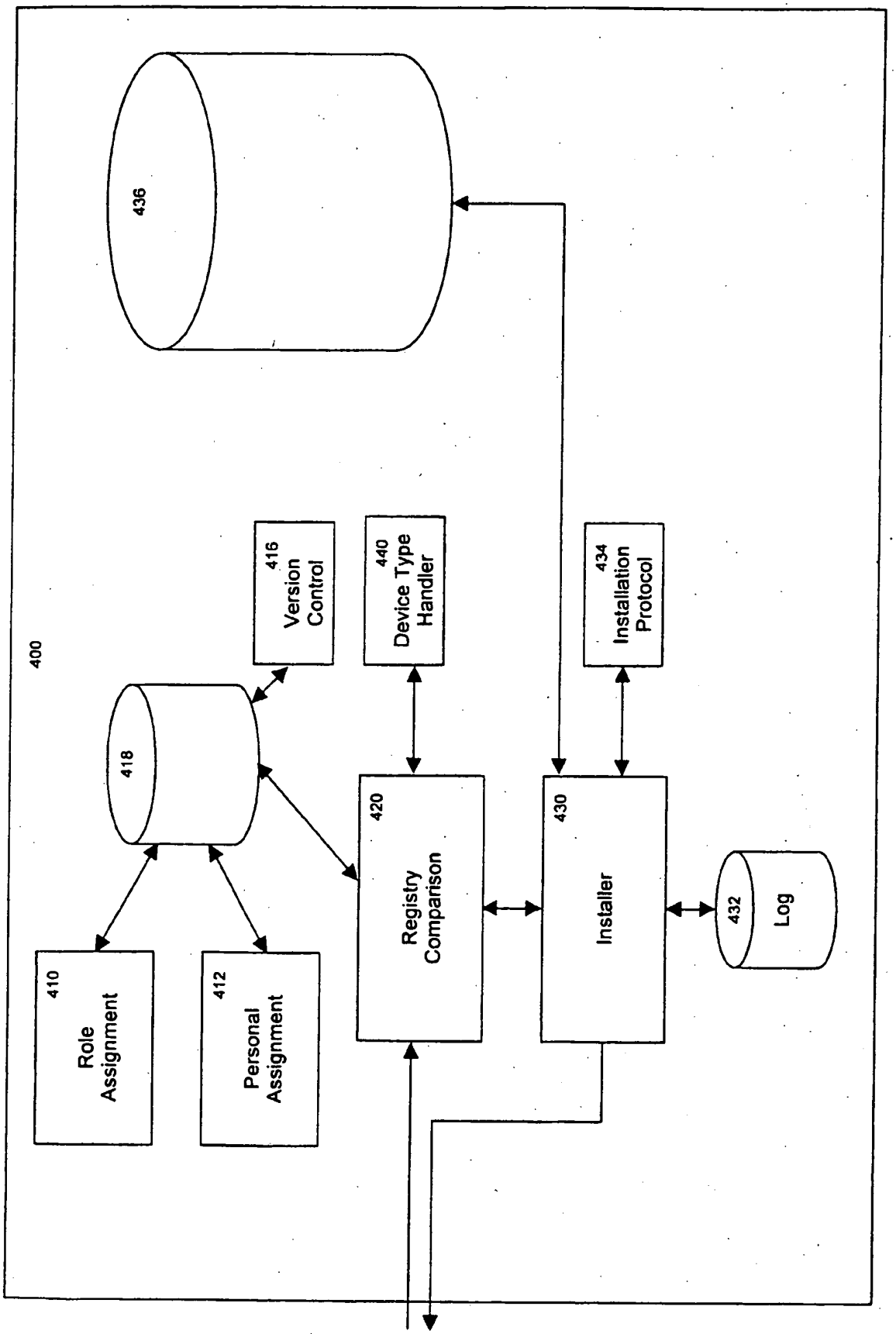
400
436
416
Version Control
440
Device Type Handler
434
Installation Protocol
418
420
Registry Comparison
430
Installer
432
Log
410
Role Assignment
412
Personal Assignment

Fig. 6

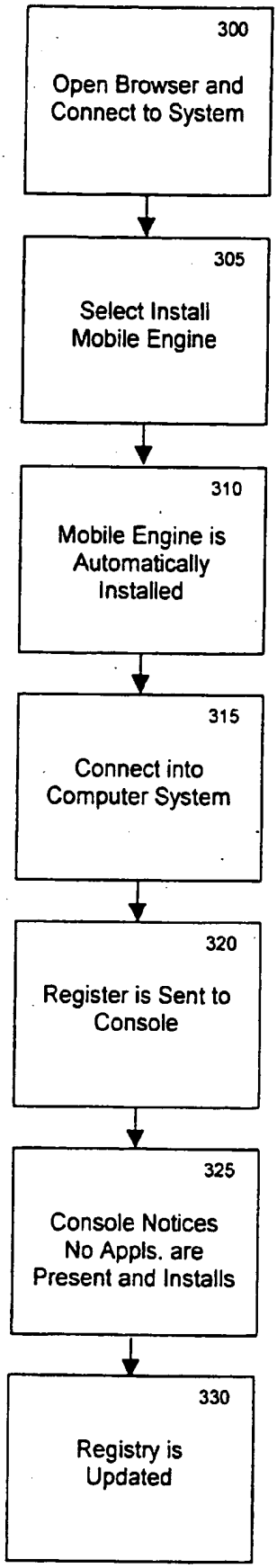
300
Open Browser and Connect to System
305
Select Install Mobile Engine
310
Mobile Engine is Automatically Installed
315
Connect into Computer System
320
Register is Sent to Console
325
Console Notices No Appls. are Present and Installs
330
Registry is Updated

Fig. 7

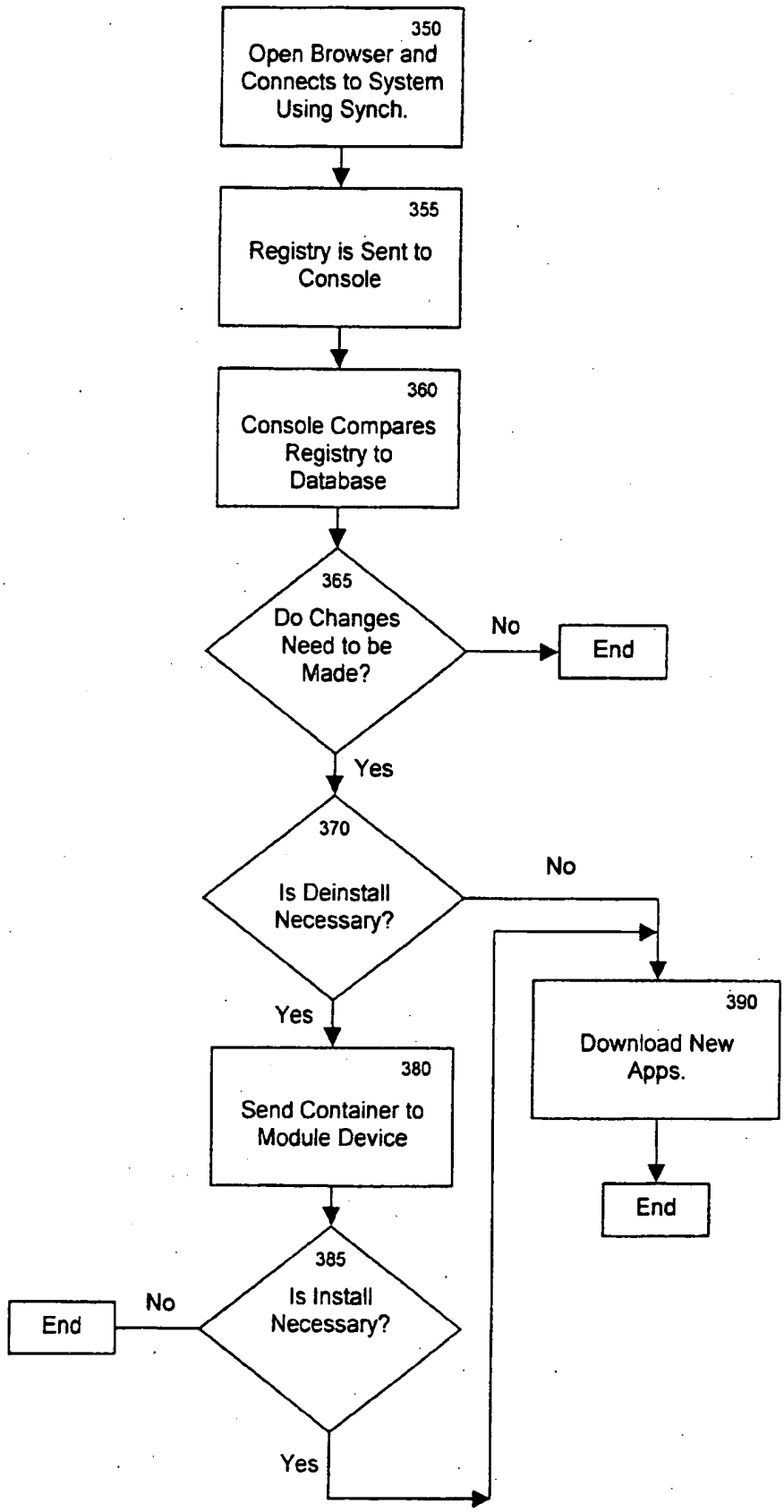
350
Open Browser and Connects to System Using Synch.
355
Registry is Sent to Console
360
Console Compares Registry to Database
365
Do Changes Need to be Made?
No
End
Yes
370
Is Deinstall Necessary?
No
Yes
390
Download New Apps.
End
380
Send Container to Module Device
385
Is Install Necessary?
End
No
Yes

Fig. 8